2 Summary of Remedial and Other Site Investigation Activities

The following sections briefly describe site investigation activities that were conducted prior to initiation of Supplemental RI activities. Details of the Supplemental RI activities begun in 2001 are provided in Section 3 (field activities) and Section 4 (data management). To the extent possible, all sampling locations and sample results are included along with the Supplemental RI data in the tables and on figures presented in subsequent sections of this report, according to the media sampled or information obtained.

2.1 Pre-RI Investigations

Several focused investigations were performed prior to the 1993 Agreed Order and initial RI work. Data from this work are discussed in the Draft RI Report (RETEC, 1996a) and presented in tables (Sections 7 through 9) in this Supplemental RI Report.

In 1973 and 1974, five test pits were excavated and three monitoring wells were installed by BNSF. These wells were destroyed in 1980. From 1990 to 1992, BNSF completed two additional voluntary phases of exploration and analytical testing in association with the removal of two underground storage tanks (USTs). The results of these investigations and UST removals are documented in a Phase I Report (GeoEngineers, 1991), a Phase II Report (GeoEngineers, 1992a), and the *Report of Geoenvironmental Services: UST Removal* (GeoEngineers, 1992b). The UST investigations included the installation and sampling of surface soil samples (SS-1 to SS-3 and SS-6 to SS-11), borings (B-1 to B-3), monitoring wells (MW-1 to MW-32), a sediment sample (SKY-1), and test pits (TP-1 and TP-2). Soil sample results indicated the presence of total petroleum hydrocarbons (TPH), polychlorinated biphenyls (PCBs), and metals (primarily lead, arsenic, and cadmium).

2.2 Overview of the Initial Remedial Investigation

The scope of the initial RI, conducted between 1993 and 1995 under the 1993 Agreed Order, included reviewing data from the previous investigations and completing additional field investigations. Records reviewed during the initial RI work included census records on local demographics, land use maps and plans (e.g., property boundaries, zoning, utilities, structures), records of climatic data, and reports on local natural and ecological resources. Fieldwork conducted during the initial RI included completion and sampling of shallow hand-auger borings (HA-1 to HA-4), collection of surface soil samples (SS-13 to SS-32, BG-1, and BG-2), drilling and sampling of new

borings (B-4 to B-12), installing eight new shallow groundwater monitoring wells (MW-33 to MW-40), installing five deep monitoring wells (DW-1 to DW-5), collecting more than 100 groundwater samples from new and existing wells, collecting surface water and sediment samples (SED-1 to SED-7 and SW-1 to SW-7), measuring groundwater and surface water elevations, collecting representative samples of LNAPL from monitoring wells (MW-22, MW-27, and MW-39), and conducting aquifer and product baildown tests in selected wells (DW-1, DW-2, DW-4, MW-5, MW-36, and MW-40).

The samples collected during the initial RI work were analyzed for a broad suite of parameters selected on the basis of historic site activities and previous investigation results. The data were then reviewed in the Draft RI Report and a list of chemicals of interest (COIs) was developed for various locations and environmental media. Toxicological data and applicable environmental standards were then used to assess the potential risk associated with the COIs.

In correspondence dated March 17, 1999, Ecology "conditionally approved" the Draft RI Report (Ecology, 1999b). Because significant changes had occurred in the MTCA regulations since the Draft RI Report was submitted in 1996, Ecology and BNSF agreed to strike Section 12 of the Draft RI Report and to defer development of site-specific cleanup levels to the FS. The Supplemental RI/FS Work Plan requires, among other things, an analysis of cleanup levels in the FS.

2.3 Post-Draft RI Report Work

Following submittal of the Draft RI Report in 1996, several data gaps were identified by BNSF, the public, and Ecology, which warranted additional investigation. Data collected during these additional investigations have been incorporated into the existing site database and are used in Sections 6, 7, 8, and 9 of this Supplemental RI Report to update our understanding of current conditions. This Section 2.3 briefly describes (in chronological order) the additional investigations performed pursuant to the 1993 Agreed Order after the initial RI work (late 1995) and prior to the Supplemental RI activities (November 2001). Note that data from all events have been incorporated into figures and tables presented elsewhere in this Supplemental RI Report, and these data have previously been reported to Ecology in Monthly Progress Reports, correspondence, or other submittals.

2.3.1 Step-Out Borings – 1995–1996

In an effort to better delineate the western extent of the LNAPL plume along the northern portion of the site, five "step-out" borings were completed in late 1995 and in 1996. The locations of these borings (SO-1 through SO-5) are shown along with Supplemental RI boring locations (Figure 3-1).

Soil samples were collected during installation of the interim action product recovery system in October 1995. These samples were collected from step-out borings SO-1 and SO-2 at 5 and 6.5 feet below ground surface (bgs), respectively. There was evidence of LNAPL at both boring locations. The sample analytical results were initially provided to Ecology in the December 13, 1995 monthly progress report.

On August 28 and 29, 1996, three additional step-out borings were drilled to the west of recovery well R-1 and the two previous step-out borings to determine the western extent of the LNAPL plume. These borings, SO-3, SO-4, and SO-5, were installed along the southern edge of the roadway at distances of 150, 200, and 300 feet, respectively, west of recovery well R-1. Borings SO-3 and SO-5 were completed as monitoring wells and are designated MW-42 and MW-43, respectively.

No evidence of LNAPL was observed during the drilling of boring SO-3; however, small droplets of LNAPL were observed on the water level probe when the well (MW-42) was gauged. As a result, additional borings SO-4 and SO-5 were completed. LNAPL was observed at the water table in SO-4 so the boring was backfilled with bentonite and an additional boring (SO-5) was drilled further west. LNAPL was not observed in boring SO-5 and LNAPL was not observed during the development or gauging of this well (MW-43). Diesel- and motor oil-range TPH were only detected in the soil sample collected from SO-4 at 7 feet bgs. Analytical results were initially presented to Ecology in the November 1996 monthly progress report and are included in the appropriate site-wide data tables and figures that accompany this Supplemental RI Report.

2.3.2 Borings for Culvert Installation – 1996

In conjunction with the step-out borings, two additional borings (NC-1 and OC-1) were drilled near the fire station south of the Old Cascade Highway (Figure 3-1). These borings were completed in an area proposed for installation of a new culvert by the Town of Skykomish and were intended to assess the potential for utility workers to encounter LNAPL during construction. Borings were drilled to the water table, at which point a soil sample was collected for analysis by Washington State Method WTPH-D Extended (x). LNAPL was not observed in either of these borings. These data were initially presented to Ecology in the November 1996 monthly progress report.

2.3.3 Blood-Lead Testing at Skykomish School by Health Department – 1996

In response to residents' concerns regarding possible exposures of children to lead in surface soil on the rail yard, the Seattle-King County Health Department tested four children in Skykomish for blood-lead in November

1996. Children who were anticipated to have the greatest likelihood of lead exposure were chosen by Washington State Department of Health (WDOH) for this testing. The results of the tests were considered normal by WDOH. The parents of the children were notified of the results. The results of this testing are not included in this Supplemental RI Report, as they are considered confidential and were not made available to BNSF. A summary of the blood-lead testing was included in Ecology's April 1999 *Summaries of Study Reports* (Ecology, 1999c), available at the Skykomish Public Library.

2.3.4 Quarterly Background Metals Groundwater Sampling – 1996

In the Draft RI Report, BNSF identified elevated total metals (unfiltered) in groundwater and noted the need for background data to determine the impacts of the former maintenance and fueling facility on groundwater and to evaluate cleanup levels that would be used in developing a final remedy. The scope of work was defined in correspondence between BNSF and Ecology in February and May 1996 (Ecology, 1996a and 1996b; RETEC, 1996b and 1996c). Monitoring wells MW-2, MW-29, and MW-33 were designated as background or reference wells and wells MW-23, MW-28, MW-31, and MW-35 (Figure 3-4) were designated as compliance monitoring wells for the BNSF facility. Background wells were sampled five times starting in February 1996 and compliance wells were sampled three times starting in May 1996. These data were combined with data from the initial RI work to perform a statistical analysis using Ecology's *Statistical Guidance for Ecology Site Managers* (Ecology, 1992). BNSF submitted a *Preliminary Evaluation of Background Metals* to Ecology on July 17, 1996 (RETEC, 1996d). BNSF's evaluation of background metals concentrations in groundwater at the site was presented in the *Background Metals Analysis* report submitted June 16, 1997 (RETEC, 1997b). This report provides a statistical analysis of the groundwater data collected in 1996. This report also includes a literature review to identify potential sources of naturally occurring metals in the Skykomish area. This report concludes that (unfiltered) metals detected in groundwater are not related to the former maintenance and fueling facility and are more likely related to naturally occurring sources. In Ecology's April 28, 1999 response to this report (Ecology, 1999d), Ecology stated that "dissolved metals concentrations are of greater concern than the total concentrations" and directed that future groundwater samples collected under the 1993 Agreed Order will be analyzed only for dissolved metals. In a follow-up letter of July 12, 1999 (Ecology, 1999e), Ecology concurred with the conclusions in the Background Metals report, stating that "the metals appear to be at background levels, therefore cleanup of the groundwater for metals does not appear to be required."

2.3.5 Quarterly Groundwater Sampling – First Year of Operation and Maintenance of the Product Recovery System – 1996

During the first year of the product recovery system operation, quarterly groundwater quality monitoring was performed (in February, May, August, and November 1996) at wells located outside the LNAPL plume. This monitoring was intended to measure changes in dissolved constituents in groundwater over four seasons. Wells MW-16, MW-19, and MW-37 to the west of the LNAPL plume and wells MW-35 and DW-5 (Figure 3-4) to the east of the LNAPL plume were monitored in each sampling round. MW-43 (Figure 3-4), located to the west of the plume, was added to the monitoring network in August 1996. Samples were collected quarterly for analysis by Method WTPH-Dx. These results were submitted to Ecology in the May 27, 1997 *Annual Product Recovery Progress Report* (RETEC, 1997a) and have been incorporated into the overall site database.

2.3.6 Water Supply Testing by Health Department – 1996–1997

The town's public water supply well is located approximately 1,100 feet east of the former maintenance and fueling facility and is upgradient of the LNAPL plume. However, in response to residents' concerns about the proximity of water distribution lines to contaminated soils and LNAPL floating on shallow groundwater, the Washington State Department of Health (WDOH) collected water samples of the Skykomish public drinking water in August 1996 and March 1997. Residents were concerned that contaminants in the soil or water near a distribution line could infiltrate into the drinking water in the event of a leak or loss in pressure. Samples were collected from two homes, the water shed on Railroad Avenue, and the school. Polycyclic aromatic hydrocarbons (PAHs) were detected during the August 1996 event in the sample collected from the water shed; however, these compounds were also detected in the laboratory blank samples so the results are likely indicative of laboratory contamination. No PAH compounds were detected in any of the samples (other than the laboratory blank) collected in March 1997. As a public water supply, the town routinely samples its system for a variety of contaminants, including PAH, and reports those results to WDOH in compliance with WAC 246-290-300(7).

2.3.7 Former Maloney Creek Soil Sampling – 1997

In response to anecdotal reports of an "oily sheen" in the sediments in the former Maloney Creek channel south of the rail yard (near a footbridge in a resident's backyard), two soil samples were collected (SS-50 and SS-51) in June 1997 (Figure 3-2). One soil sample was collected from the south side of the creek, approximately 15 feet east of the footbridge, and a second sample

was collected approximately 11 feet west of the footbridge. At the time of sampling, no petroleum odor or sheen was observed in the creek and there were no signs of oil or stained vegetation in the area. Near S-51, east of the footbridge, some darker surface soils were encountered which extended to depths of a few inches, suggesting that the creek may be impacted by runoff or some other surface source.

Diesel- and motor oil-range TPH was detected in both soil samples. The analytical results for these samples were included in the August 17, 1997 monthly progress report (RETEC, 1997e). The chromatograms from the laboratory analyses were compared to chromatograms from the LNAPL encountered at the former maintenance and fueling facility to determine whether the type of TPH present in soil near the creek was the same as the TPH detected at the rail yard. The chromatograms show that the TPH in soil samples near the creek are heavier range hydrocarbons than the TPH present at the rail yard.

2.3.8 Site-Wide Groundwater Sampling – 1997

On October 3 and 6, 1997, BNSF conducted a site-wide groundwater sampling event pursuant to the 1993 Agreed Order. The sampling was conducted to update the groundwater quality database. Twenty-eight wells were sampled during October 1997 (Figure 3-4). The results of this event were presented in a letter report to Ecology dated March 11, 1998 (RETEC, 1998b), and have been incorporated into the overall database for the former maintenance and fueling facility.

Gauging performed for the October 1997 sampling event indicated that the extent of dissolved contaminants in groundwater has remained roughly the same as during previous sampling events and have not moved or changed appreciably since the initial RI activities (1993–1995). In general, TPH concentrations were greatest at locations closest to the LNAPL plume. Two locations, MW-11 and MW-42, contained TPH at concentrations indicative of the presence of entrained LNAPL (63 and 25 mg/L, respectively). Beyond the rail yard property, TPH concentrations decrease to non-detectable levels within a short distance from the LNAPL plume. Dissolved TPH concentrations were slightly higher on the rail yard property, ranging from non-detect up to 14 mg/L (MW-15, duplicate sample). PAHs were detected in seven of the ten wells sampled, but carcinogenic PAHs were detected in only five wells. In general, wells located south of the railroad tracks, east of 5th Street, and wells located near the LNAPL plume contained PAHs. The specific PAHs detected were distributed somewhat sporadically, indicating that PAHs are a component of the TPH present in the subsurface.

2.3.9 Semiannual Groundwater Sampling – Second Year of Operation and Maintenance of the Product Recovery System – 1997

As part of the operation and maintenance of the product recovery system, monthly gauging and quarterly groundwater sampling continued through June 1997 under the 1993 Agreed Order. After June 1997, the revised monitoring schedule, presented in the *Annual Product Recovery Progress Report* (RETEC, 1997a), took effect under the 1993 Agreed Order. Under the revised schedule, semiannual site-wide gauging was conducted starting in October 1997, and a modified water quality sampling program was initiated. The modified water quality sampling program included sampling wells MW-24, MW-26, MW-37, and R-3 annually, and sampling MW-43 semiannually (Figure 3-4). The site-wide sampling event, discussed in Section 2.3.8 above, served as the October 1997 semiannual sampling and the results of that event were presented in a letter report to Ecology dated March 11, 1998 (RETEC, 1998b). The results of other groundwater samples collected during the second year of the recovery system operation were presented in the *Annual Product Recovery Progress Report for March 1997–March 1998* (RETEC, 1998c), submitted to Ecology on May 29, 1998. The nature and extent of the LNAPL plume and dissolved TPH plume remained largely the same as in previous events.

2.3.10 Indoor Air Sampling – 1997–1999

Indoor air sampling was performed in six buildings in response to requests by Skykomish residents. A Scope of Work and Sampling and Analysis Plan (SOW and SAP) were submitted to Ecology on July 1, 1997 (RETEC, 1997c), and addendums to this document were issued on July 14, 1997 and January 8, 1998 (RETEC, 1997d and 1998a). Ecology approved the SOW and SAP under the 1993 Agreed Order. The sampling program consisted of LNAPL headspace analysis, to assess what compounds may volatilize from LNAPL associated with the former maintenance and fueling facility, followed by four quarterly and three "mid-quarter" indoor air sampling events over the period of August 1997 to February 1999. Indoor air samples were collected from three residences located over or adjacent to the LNAPL plume, two classrooms in the Skykomish School, the Post Office, and a "control" house located away from the LNAPL plume (Figure 2-1). The "control" house was included to distinguish "normal" indoor air quality from indoor air potentially affected by the LNAPL underlying the buildings. The results of the sampling program are presented in the *Final Report on Indoor Air Sampling* (ThermoRetec, 1999c). The results were interpreted by experts retained by both BNSF and Ecology, who concluded that LNAPL associated with the former maintenance and fueling facility is not impacting indoor air quality. The WDOH communicated this conclusion to the public by issuing an

"Environmental Health Update" in June 1999 (WDOH, 1999) and presenting their findings at a public meeting in Skykomish.

2.3.11 Abandonment of Monitoring Well MW-33 – 1998

Well MW-33 (Figure 3-4), located in the road on Railroad Avenue, periodically caused problems for the town's snowplow as the well at times protruded slightly above grade. With Ecology's approval under the 1993 Agreed Order, on December 29, 1998 ThermoRetec personnel supervised the abandonment of MW-33. At the same time, MW-35, which had been covered with asphalt during previous roadwork, was located and placed back into service. No problems were encountered during this work, which was reported in the January 12, 1999 monthly progress report to Ecology (ThermoRetec, 1999d).

2.3.12 Semiannual Groundwater Sampling – Third Through Fifth Years of Operation and Maintenance of the Product Recovery System – 1998–2001

Semiannual groundwater sampling was conducted pursuant to the 1993 Agreed Order during the third, fourth, and fifth years of product recovery system operation. The results were submitted to Ecology in Annual Progress Reports dated April 23, 1999, June 26, 2000 and November 9, 2001 (ThermoRetec, 1999b, 2000a, 2001c). In all cases, the LNAPL plume and dissolved contaminants were generally consistent with previous investigation sampling events, with detectable levels of diesel-range or motor oil-range TPH encountered in wells immediately surrounding the LNAPL plume, and low or non-detectable levels observed in wells farther from the LNAPL plume.

2.3.13 TPH Soil Sampling and Fractionation Analysis – 1999

In 1999, soil samples were collected and analyzed by the volatile petroleum hydrocarbons/extractable petroleum hydrocarbons (VPH/EPH) method to develop site-specific TPH cleanup levels in accordance with the procedures detailed in Ecology's Interim TPH Policy.[1] On March 19, 1999, 16 soil samples and two duplicates were collected from eight test pits on railroad property (TPHTP-1 through TPHTP-8). This sampling was performed under the 1993 Agreed Order and in accordance with the technical memorandum

[1] The Interim TPH policy has been replaced with new procedures under the 2001 amendments to the MTCA regulations. The new procedures will be used for development of site-specific cleanup levels in the FS.

submitted to Ecology on November 24, 1998 (RETEC, 1998d), and revised and approved per Ecology's correspondence dated March 11, 1999 (Ecology, 1999a). Sample results and a draft of the TPH cleanup level calculations were sent to Ecology on May 27, 1999 (ThermoRetec, 1999e). Ecology approved the soil cleanup levels derived from these calculations in a letter dated July 12, 1999 (Ecology, 1999e). Since the Interim TPH Policy and associated procedures for development of cleanup levels were revised again by Ecology in the 2001 amendments to the MTCA regulations, new site-specific cleanup levels will be developed in the FS.

2.3.14 Background Soil Sampling for Metals – 1999

Metals in soil were evaluated in the Draft RI Report (RETEC, 1996a). Several metals were detected in soil from the former maintenance and fueling facility during the initial RI work at concentrations below then-current MTCA Method A or Method B cleanup levels. Because site-specific cleanup levels could be developed in the FS using, among other things, natural background levels and site-specific exposure parameters, in 1999 BNSF conducted a study of background metal concentrations in soil in the Skykomish area.

On June 11, 1999, 10 soil samples and one duplicate (BG-101 to BG-110) were collected from remote locations surrounding Skykomish. Sample locations were intended to be close enough to the former maintenance and fueling facility to be similar geologically, but far enough from railroad tracks and other development not be impacted by human activities, such as passing trains. Because the samples were located remotely and without GPS readings or survey markers, they are not presented on figures or tables. Sample locations based on field notes, analytical results, and background calculations are presented in Appendix G to this Supplemental RI Report and were previously reported in Appendix D of the Draft Feasibility Study (ThermoRetec, 1999a).

Calculated site-specific concentrations of arsenic, chromium, copper, lead, nickel, and zinc were higher than Ecology's published "state-wide" natural background concentrations. The results of the 1999 sampling for metals will be considered in developing cleanup levels in the FS.

2.3.15 Collection of Groundwater Beneath LNAPL – 1999 and 2000

At a May 13, 1999 meeting between BNSF and Ecology, Ecology requested that BNSF collect groundwater samples from beneath the LNAPL plume to evaluate the extent of dissolved-phase impacts to groundwater below the plume. BNSF's work plan for sampling pursuant to the 1993 Agreed Order was included in correspondence to Ecology dated June 17, 1999 (ThermoRetec, 1999f). On July 2, 1999, a groundwater sample was collected from MW-25 (Figure 3-4) beneath the LNAPL layer. Analytical results were

submitted to Ecology with the August 13, 1999 monthly progress report (ThermoRetec, 1999d). TPH was detected in this sample at a concentration approximately equal to the calculated solubility of the LNAPL encountered at the former maintenance and fueling facility.

In November 2000, groundwater beneath LNAPL in wells MW-8, MW-25, and MW-36 was collected as part of the site-wide sampling event pursuant to the 1993 Agreed Order, noted below in Section 2.3.16. These samples were analyzed by EPH/VPH (fractionation) methods. The data from the 2000 groundwater sampling events were reported to Ecology in the January 2001 monthly progress report dated February 15, 2001, and the Annual Progress Report for 2000 (ThermoRetec, 2001c) and have been incorporated into the overall database. Analytical laboratory reports are included in Appendix E.

2.3.16 Site-Wide Groundwater Sampling/LNAPL Thickness Measurements – 2000

A revised site-wide groundwater sampling plan was submitted to and approved by Ecology in November 2000 (ThermoRetec, 2000b) pursuant to the 1993 Agreed Order. On November 20, 2000, site-wide groundwater gauging was performed followed by groundwater sampling on November 21 and 22 and LNAPL thickness measurements on November 29. The final results are included in the Annual Progress Report for 2000, dated November 9, 2001 (ThermoRetec, 2001c). LNAPL thicknesses ranged from less than 0.1 foot to over 3 feet, with the most LNAPL observed in MW-36. Groundwater TPH concentrations were consistent with prior groundwater sampling events in 1996 through 1999.

2.3.17 Biological Sediment Sampling – 2001

Sediment sampling was performed on July 10, 2001, pursuant to the 1993 Agreed Order, following the Sediments Sampling and Analysis Plan submitted to Ecology on June 5, 2001 (ThermoRetec, 2001a). Ecology was present to oversee the work and collect split samples. Surface sediment samples were collected from the banks of the Skykomish River from four seep areas (SED-11, SED-12, SED-13, and SED-14), a downstream reference site (SED-10), and an upstream reference station on the opposite riverbank (SED-16). Sample locations are discussed in Section 3 (Figure 3-3). Sediment samples collected by RETEC were analyzed for grain size, sulfide, ammonia, total organic carbon, total solids, total volatile solids, and total petroleum hydrocarbons (diesel extended). Toxicity testing for samples collected by RETEC consisted of: (1) *Chironomus tentans* 10-day growth and mortality, (2) *Chironomus tentans* 20-day growth and mortality, (3) Hyalella azteca 10-day growth and mortality, and (4) Microtox® as defined by Ecology's 100 percent pore water protocol (P. Adolphson, October 7, 2000). These data were presented to Ecology in a letter report dated December 7, 2001 (RETEC, 2001c) and are included in Section 9 of this report.

BNSF also completed voluntary benthic infaunal analysis of sediments on July 19, 2001, to assist with understanding impacts on the biological resources in the river. The results of this sampling were removed from the Supplemental RI at Ecology's direction. BNSF will submit this information to Ecology in a separate Technical Memorandum, to be placed in the agency's administrative record for the Site.